FANOX

protection & control

Low Voltage

APPLICATION GUIDE

- Electronic Protection & Control of Motors, Generators and Pumps
- Control & Measurement
- Earth Leakage Protection
- Surge Protection
- Brandlabeling & Custom products

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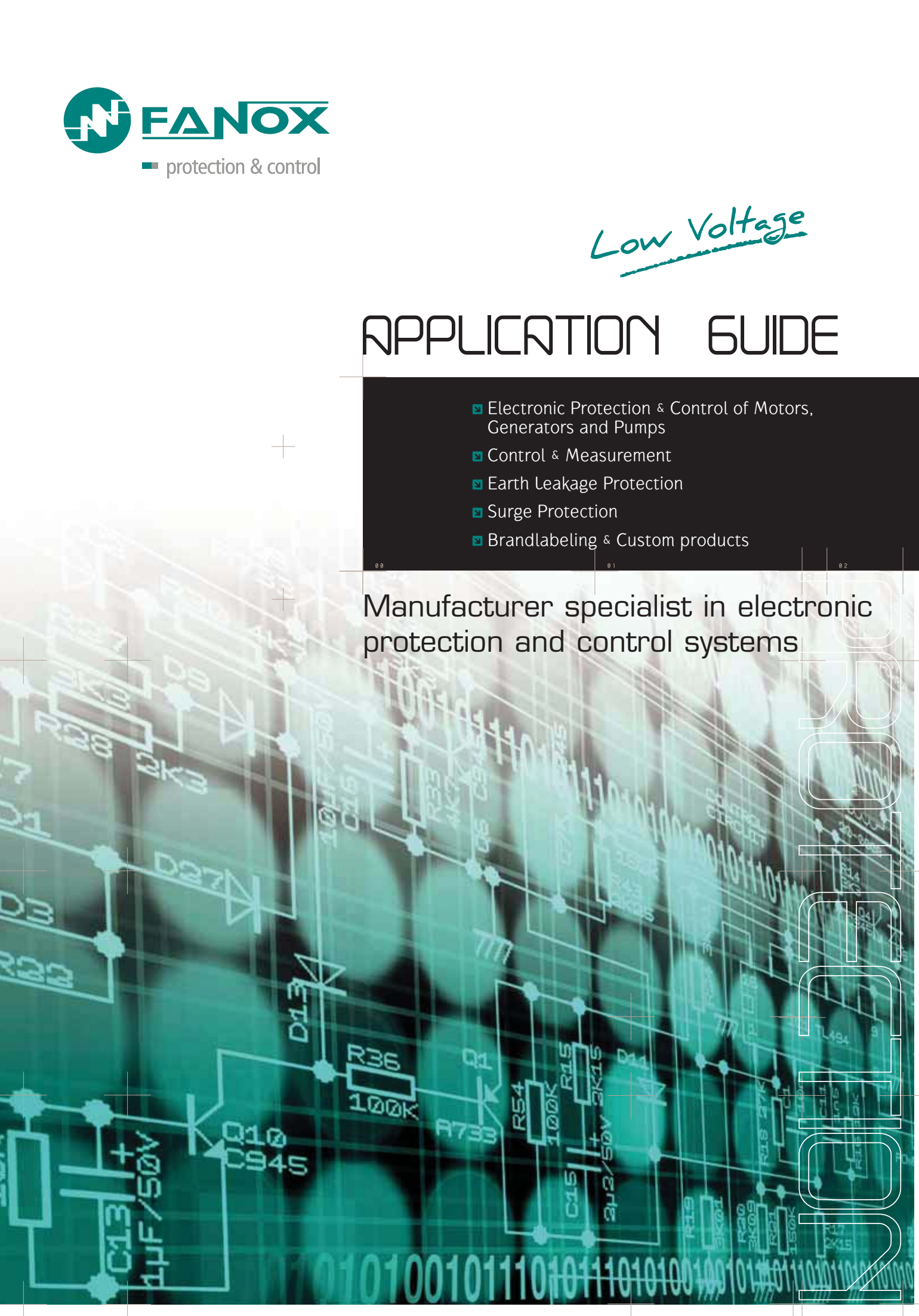
Manufacturer specialist in electronic protection and control systems



The last decade has been a period of strong growth and international expansion for Fanox, making us one of the leading companies specializing in the design and manufacture of electronic relays for Low and Medium Voltage applications.

Since its founding back in 1992, we have developed a wide range of products for multiple applications in the low voltage sector, designing and launching new products to the market every year. These products have always been designed with one major focus; namely to reduce and save high installation and running costs for end user.

FANOX' international growth, has also led to expansion into the medium sector. Our MV Division is now one of the main focus areas of development, thanks to the decisive contribution of a highly qualified R&D department.

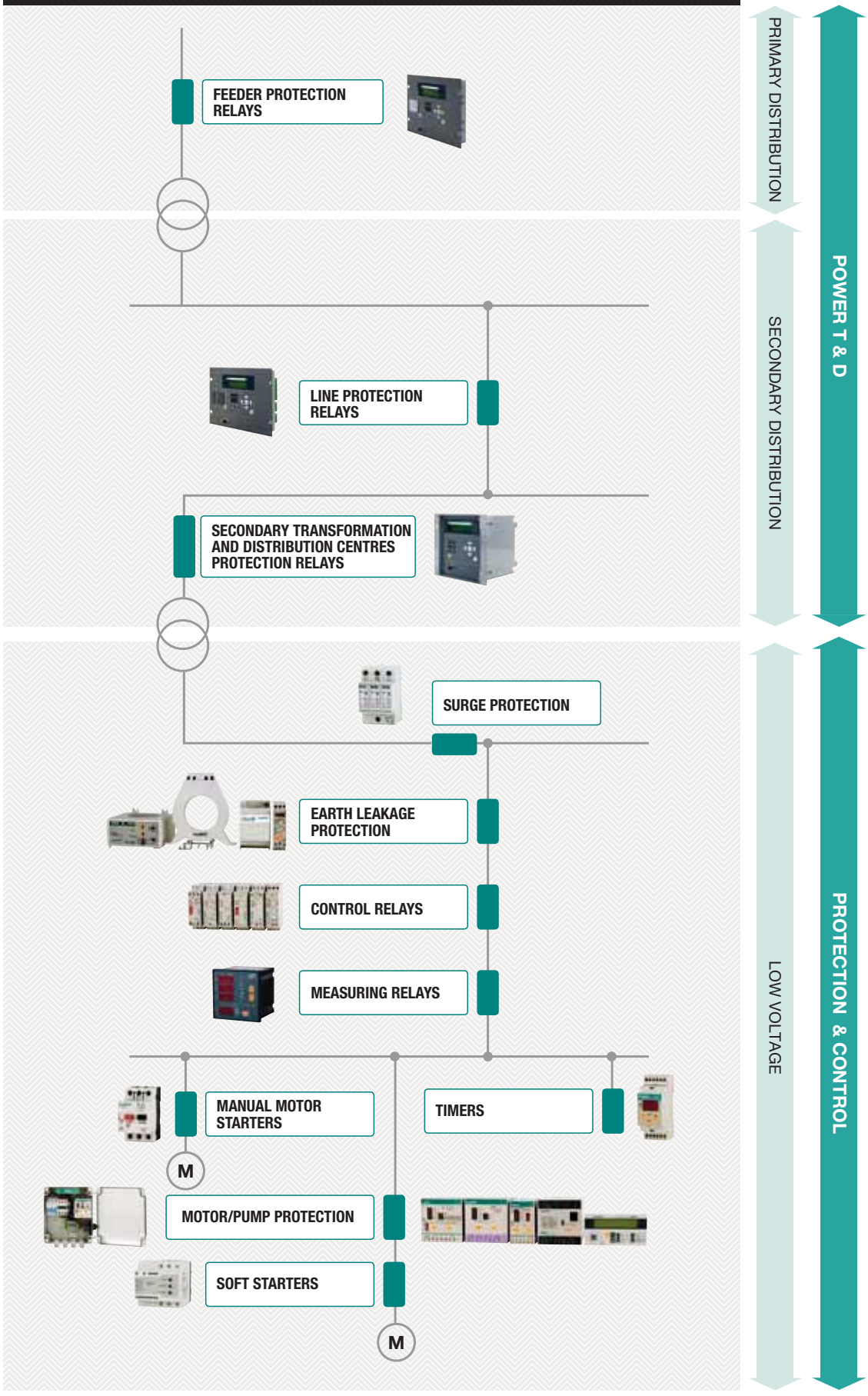
Resting on a strategy of sustainable growth, solid management capabilities and a very high technological potential, Fanox meets the future with a solid outlook, where we will be able to respond successfully to challenges thrown at us.

With the Quality Management System based on ISO 9001:2008 Fanox guarantees the highest quality services and products to its customers' satisfaction.

Fanox products meet the most relevant international standards. We carry the CE marking and have UL approvals (Underwriters Laboratories) for USA, c-UL for Canada and the PTB (Physikalisch-Technische Bundesanstalt) for EEx e motors working in explosive atmospheres (ATEX Certified).

Fanox' human resources have undergone a tremendous growth over the past decade, becoming a highly specialized team with high capacity for adaptation and development. It is a multicultural team which faces the challenges set by a strategic business plan which has its people and integrity as its main values.

FANOX PRODUCTS



PROTECTION

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ELECTRONIC PROTECTION & CONTROL OF MOTORS, GENERATORS AND PUMPS

Introduction

Fanox designs and manufactures the most reliable protection & control relays in the market. Products that efficiently prevent engine burnouts, saving costly repairs and preventing dreaded and unnecessary downtime in any important process.

The electric motor is one of the most important drives in industry, and plays a decisive role in the success of a production process. Valuable production processes and high value machinery can be completely paralyzed by one single motor failure. This poses the risk of great expenses, with the resulting costs significantly exceeding the cost of repairing the motor itself.

Experience shows that motor protection is still a novelty, and still not a priority amongst users. The high numbers of faults that occur every day are mainly due to overloads, locked rotor, phase failure or imbalance, heavy bursts of long duration or high duty cycle of operations, or overheating.

Over 60% of failures are due to causes not detected by conventional protection systems, causing excessive heat in the windings, leading to a drastic reduction of the electrical life of the motor.

The most significant technical advantages of Fanox designed equipment is:

- Continuous Thermal image memory of heating and cooling cycles of the engine's starting cycles, work overload and stoppages.
- The prompt detection of phase loss, even with the engine running at low loads, stopping quickly to avoid costly breakdowns.
- Identification of trip cause. The relays indicate the reason for tripping instantly allowing you to identify and act quickly on faults.

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PBM Protection, control and monitoring system

MOTOR MANAGEMENT SYSTEM

INTEGRAL SOLUTION FOR MCCs ADAPTABLE TO EVERY CUSTOMER NEEDS

MULTIFUNCTION

FAULT REPORTS

4 fault reports with the following information: dates, measurements, status bits, inputs ans outputs.

SELF-DIAGNOSIS, INSTALLATION MONITORING AND STATISTICS

- Earth toroidal disconnection monitoring.
- PTC sensor open circuit and short circuit detection.
- Magnetic module hardware monitoring.
- Non-volatile memory stored information coherence.
- Number of motor start ups.
- Medium and maximum current of last start up.
- Number of faults for the following functions: Overload, PTC, JAM, locked rotor and neutral faults.
- Operating hours counter.

TEST MENU

Operation check on LEDs and outputs.

DESIGNED FOR SCADA APPLICATIONS

RTU Modbus protocol and RS485 communication

MODULAR AND SCALABLE

The basic functions of the system can be extended with different modules (PBM H, PBM D...)

COMMUNICATION SOFTWARE PBCom

PBM B

PBM H

PROTECTION FUNCTIONS

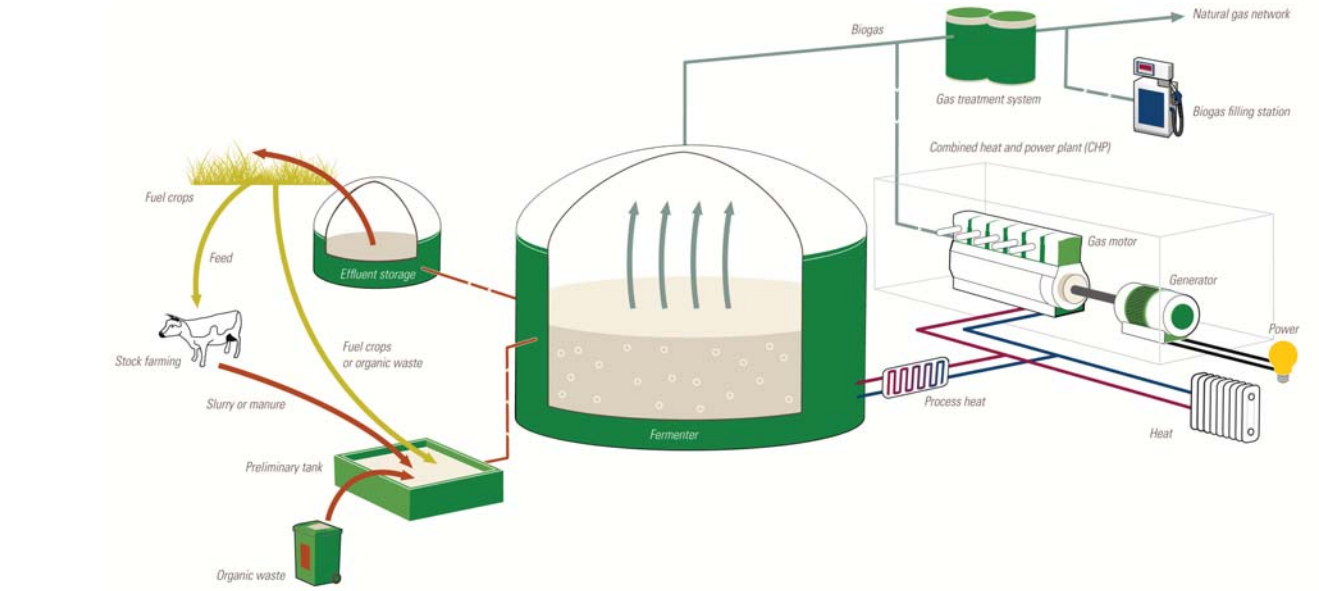
- $\theta>$ Overload with thermal image
- Overheating protection (PTC sensor)
- Phase imbalance or phase failure
- Phase sequence
- JAM JAM detection
- Locked rotor detection
- $I_g>>$ Instantaneous earth leakage overcurrent
- $I_g>$ Earth leakage inverse time overcurrent
- $I_0>>$ Instantaneous neutral overcurrent
- $I_0>$ Neutral inverse time overcurrent
- $I<$ Undercurrent

CE cULus LISTED

APPLICATION MODEL

One area where the PBM motor protection relay applies is in renewable energy, particularly in the use of biomass for bioenergy.

The way to convert biomass into energy depends mainly on the type of biomass being treated and the destination you want to give to this energy. The bioenergy sector is based on three modes of energy use: for heating, electricity generation and biofuel production.



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ADVANTAGES OF BIOMASS

- Decreases the production of greenhouse gases and produces no pollutants sulfated or nitrogen (which are the cause of acid rain).
- Waste vegetable field plantations are reused.
- Biofuels are not as polluting as fossil fuels, are non-toxic, biodegradable and promise to solve the problem of pollution generated by automobiles.
- It is a great help against accumulation of animal waste that cause infectious centers and uncontrolled combustion.

BIOMASS TRANSFORMATION PROCCESS

GASIFICATION:

1 Fuel In-Feed System

The metering bin provides short-term fuel storage and ensures a constant supply of fuel to the gasifier. Fuel is conveyed by a horizontal auger from the metering bin to a vertical auger that pushes fuel into the base of the fuel pile inside the gasifier.

2 Gasifier

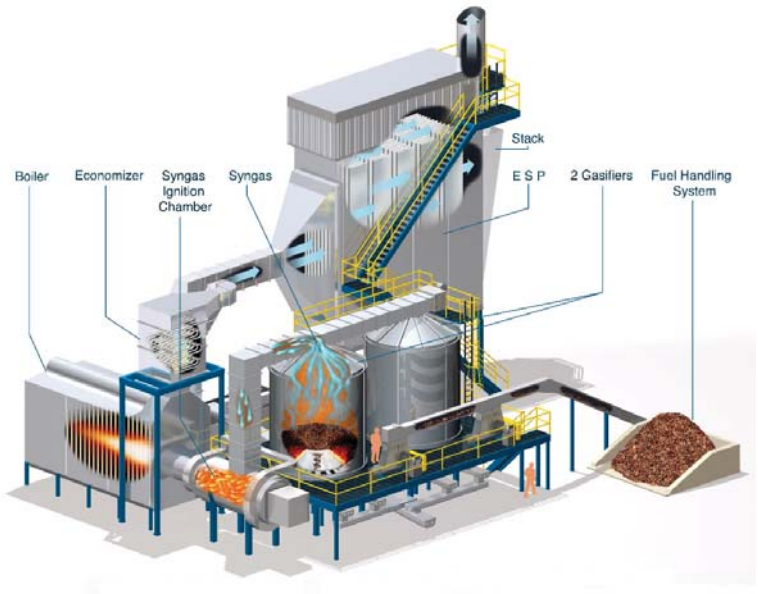
Within the gasifier, the fuel moves through progressive stages of drying, pyrolysis, gasification and reduction to ash. Combustion air (20 - 30% of stoichiometric), steam and/or oxygen are introduced through the inner and outer cone into the base of the fuel pile. Partial oxidation, pyrolysis and gasification occur at 1500 — 1800 °F (815 – 980 °C), and the fuel is converted into “syngas” and non-combustible ash. Combustion temperatures in the fuel pile are tightly controlled and kept below the ash melting temperatures to ensure that there is no formation of “clinker” and that the ash flows freely.

3 Automatic Ash Removal System

As the fuel is processed in the system it is reduced to non-combustible ash. The ash migrates to the grate at the base of the gasifier where it is removed intermittently through a set of openings. When hydraulically activated, the rotating grate opens and the ash drops into two ash hoppers. Each ash hopper has two parallel augers to convey the ash to a collection conveyor and an enclosed ash bin.

4 Syngas

Syngas exits the gasifier at 500 — 700 °F (260 – 370 °C). The syngas can be combusted in a close-coupled oxidizer with the resulting flue gas directed to heat recovery equipment (e.g., boilers, thermal oil heaters, air-to-air heat exchangers), fired directly in industrial boilers or kilns, or cleaned for use in the firing of internal combustion engines or the production of higher value gases and chemicals.



COMBUSTION:

By far the most common means of converting biomass to usable heat energy is through straightforward combustion, and this accounts for around 90% of all energy attained from biomass.

1 Fixed Bed Combustion:

There are two prominent types of fixed bed combustion: underfeed stokers and grate firings. With these methods of combustion air is primarily supplied through the grate from below, and initial combustion of solid fuel takes place on the grate and some gasification occurs. This allows for secondary combustion in another chamber above the first where secondary air is added.

» Underfeed Stokers

Generally only suitable for small-scale systems, underfeed stokers are a relatively cheap and safe option for biomass combustion. They have the advantage of being easier to control than other technologies, since load changes can be achieved quickly and with relative simplicity due to the fuel feed method. Fuel is fed into the furnace from below by a screw conveyor and then forced upwards onto the grate where combustion process begins. Underfeed stokers are limited in terms of fuel type to low ash content fuels such as wood chips. Due to ash removal problems it is not feasible to burn ash rich biomass as this can affect the air flow into the chamber and cause combustion conditions to become unstable.

» Grate Firings

There are several different types of grate firing, with both fixed and moving grates commonplace. They have the distinct advantage over underfeed stokers in that they can accommodate fuels with high moisture and ash content as well as with varying fuel sizes. It is very important that fuel is spread evenly over the grate surface in order to ensure that air is distributed uniformly throughout the fuel and thus combustion is kept homogenous and stable. There are a number of different types of grate firing including fixed grates, moving grates, rotating grates and travelling grates.

2 Fluidised Bed Combustion Systems

Fluidised bed furnaces operate in quite a different manner from fixed bed furnaces and have a number of advantages associated with them. There are two main types of fluidised bed furnace, Bubbling Fluidised Bed (BFB) and Circulating Fluidised Bed (CFB).

» Bubbling Fluidised Bed (BFB) Furnaces

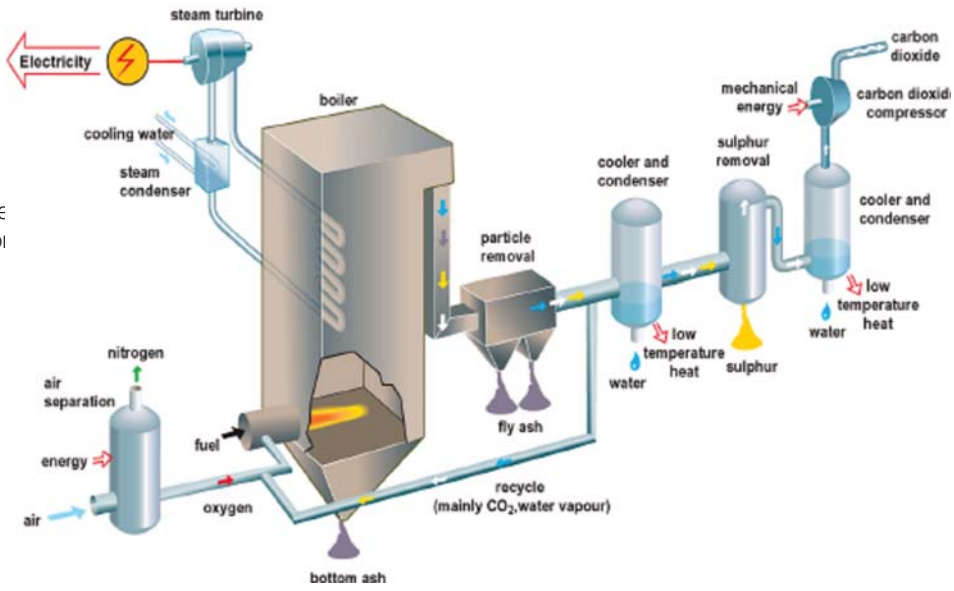
The fundamental principle of a BFB furnace is that the fuel is dropped down a chute from above into the combustion chamber where a bed, usually of silica sand, sits on top of a nozzle distributor plate, through which air is fed into the chamber with a velocity of between 1 and 2.5m/s. The bed normally has a temperature of between 800 and 900°C and the sand accounts for about 98% of the mixture, with the fuel then making up a small fraction of the fuel and bed material.

BFB's have two main advantages in terms of fuel size and type over more traditional fixed bed systems. Firstly they can cope with fuel of varying particle size and moisture content with little problem, and secondly they can burn mixtures of different fuel types such as wood and straw. BFB's are only a practical option with larger plants with a nominal boiler capacity greater than 10 MWth.

» Circulating Fluidised Bed (CFB) Furnaces

If the air velocity is increased to 5-10m/s then a CFB system can be achieved, where the sand is carried upwards by the flue gases and a more thorough mixing of the bed material and fuel takes place. The sand is then separated from the gas in a hot cyclone or U beam separator at the top of the furnace and fed back into the combustion chamber where the whole process begins again.

CFB's deliver very stable combustion conditions but it comes at a cost. Due to their larger size compared to other combustion methods the cost is relatively high and there are problems involved with fuel size, which must be very small, and the difficulties involved in running them at partial load. All of this means that they are really only feasible for plants with a boiler capacity of over about 30MWth.



CONCLUSIONS

As can be seen in the description of the processes and analyzing the criticality of all and each of the steps, it is interesting to see the multiple places where different power and characteristics motor can be employed to face the process completely.

Motors to enable the transfer of material to the chambers, motors for milling, as drive motors for gates that allow the removal of ashes, driving fans and extracting fans for optimal process conditions, auxiliary services for all the process, ...

In every step of this application you can find motor with maimum and critical functionality. Therefore, it is essential to have full motor protection equipment, such as PBM, allowing minimizing motor failure and hours generated for repairing or replacement, as these hours represent unproductive costs, which affect all process.

EXAMPLE FOR PBM APPLICATION

One of the examples where it is necessary to use protection relay are conveyor motors, which are responsible for carrying the material from the storage silo to the combustion or gasification chamber. It is important that the material conveying cycle is maintained and continuous so that the process conditions are well defined, therefore, the protective relay of the driving motor must be able to detect that:

- Conveyor starts correctly (start-up control cycle).
- There is load being moved to the chamber (underload protection)
- The charge level is acceptable and not feeding chamber excessively (JAM, locked Rotor).
- Oher requirements.....

Additionally to previous protection functions, standard motor protection are also availble. Also must be able to provide information regarding the life of the motor to be able to decide when to scheduled preventive maintenance rather than be forced to do repair work interrupting the process.

COMMUNICATION AND CONTROL

Today, it is very important the availability of communicated and integrable systems that enable to have full control and access to our equipments remotely.

The PBM is a communicated system that allows, both, adjust our relays to new operating conditions required, and also collecting information to analyze it at office.

Thus, we have an integrated and smart system that provides us greater control of our entire process and installation.

OTHER APPLICATIONS

The PBM System, as complete motor protection mechanism, can be installed in almost all the industrial process that can be analyzed. Indeed, some of the application where Fanox PBM is working now are:

- Biomass Central for bioenergy in Spain.
- Amsterdam Underground ventilation system.
- Repsol Petrol Station for water pumps.
- Plastic manufacturing plants.

MENU DESCRIPTION

The best way to understand the functioning of the PBM System is to navigate through the menus to discover the possibilities that they offer.

The menu is absolutely simple to manage and allows a fast and adequate set of all the parameters necessary to provide the best protection to your motor.

STATES allows the monitoring of the situation of motor in relation to protection function (if there is fault conditions or not), inputs, outputs, and other parameters.

MEASURES allows to monitor the values of the electrical parameters that relay is checking to implement the protection algorithms (Iphase, Ineutral, Iearth, thermal image, frequency, Iavg, I1 and I2).

SETTINGS allows to define the parameters of the motor and protection levels selected by the user that must be known by the relay to provide the best protection standard (general, protection functions, reset, communication).

COMMAND provides the possibility of sending the “reset” order to several parameters as “statistics”, “working time” and “thermal image”.

CONFIGURATION allows to define the way of lightining of the LED indicators included in HMI display. 16 bits OR can be defined for each one, selecting also the way of lighting (latch or flashing).

REPORTS includes 4 registries that have the complete information of the states and values of all the parameters occurred during a trip. Date and time is stamped in all fault reports.

STATISTICS provide complete information of the life-time of the motor in order to have the capacity to decide about the state of the motor and the necessity of performing maintaining or repairing actuations.

DATE & TIME allows to define and adjust, thanks to RTC, in local mode or by communication the actual date and time to have the correct stamp in the registries.

PASSWORD allows the user to define and change the access code to modify all the writable parameters of the relay. If incorrect password is introduced during setting process, no changes will be applied.

The complete description of the navigation menu is included in the complete edition of the User’s Manual

PC SOFTWARE PBCOM

Software for configuration interface and programmable relay data visualization.

Allows selection of the language by clicking one of the four options available:

Thanks to the PBCom PC Software it is possible to adjust easily our PBM motor protection system and to have it ready at any moment, to be able of starting up our installation as soon as possible.

Even, it is also possible to create, save, upload and download the settings into a TXT file, easy to manage, that allows us to set a complete group of protection relays with the same settings just by charging the file into the relay through the PC Software.